NOAA Scientific Publications Report
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Highlighted Articles

Assessing trade-offs to inform ecosystem-based fisheries management of forage fish

Nature: Scientific Reports

An integrated assessment of habitat quality of National Estuarine Research Reserves (NERRs) in the Southeastern U.S.

Integrated Environmental Assessment and Management (IEAM)

Additional Articles

NMFS Publications

Synchronized migration phenologies prevent trophic mismatch in a warming watershed

Freshwater Biology

Reducing bias and improving precision in species extinction forecasts

Ecological Applications

Clarification on the fecundity of *Rhinoptera bonasus* (Mitchill)

Southeastern Naturalist

NOS Publications

Potential larval sources, destinations, and self-seeding patterns in the Mariana Archipelago documented using ocean drifters

Journal of Oceanography

NESDIS Publications

Calculation and evaluation of an air-freezing index for the 1981-2010 climate normals period in the coterminous United States

Journal of Applied Meteorology and Climatology

Extended reconstructed sea surface temperature version 4 (ERSST.v4), part I. Upgrades and intercomparisons

Journal of Climate

Joint Line Office Publications

Changes in nitrogen oxides emissions in California during 2005-2010 indicated from top-down and bottom-up emission estimates

Journal of Geophysical Research: Atmospheres

Bias adjustment of AVHRR SST and its impacts on two SST analyses

Journal of Atmospheric and Oceanic Technology

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

Great Lakes water levels surge, return to normal

EOS

HIGHLIGHTED ARTICLES

Assessing trade-offs to inform ecosystem-based fisheries management of forage fish

Nature: Scientific Reports

A. O. Shelton, **J. F. Samhouri**, A. C. Stier, and **P. S. Levin (NMFS/NWFSC)**

- The authors developed stochastic, age structured models to assess the interaction between fisheries, herring populations, and the persistence of predators reliant on herring populations.
- The authors provide a general template to evaluate ecosystem trade-offs between stage-specific harvest practices in relation to environmental variability, the risk of fishery closures, and the risk of exceeding ecosystem thresholds intended to ensure conservation goals are met.

Twenty-first century conservation is centered on negotiating trade-offs between the diverse needs of people and the needs of the other species constituting coupled human-natural ecosystems. Marine forage fishes are a nexus for such trade-offs because they are both central nodes in marine food webs and targeted by fisheries. An important example is Pacific herring, *Clupea pallisii*, in the Northeast Pacific. Herring populations are subject to two distinct fisheries: one that harvests adults and one that harvests spawned eggs. The authors developed stochastic, age structured models to assess the interaction between fisheries, herring populations, and the persistence of predators reliant on herring populations. They showed that egg- and adult fishing have asymmetric effects on herring population dynamics - herring stocks can withstand higher levels of egg harvest before becoming depleted. Second, ecosystem thresholds proposed to ensure the persistence of herring predators do not necessarily pose more stringent constraints on fisheries than conventional, fishery driven harvest guidelines.

Expected publication date: Winter 2014

Published Online: http://www.nature.com/srep/2014/141119/srep07110/full/srep07110.html

An integrated assessment of habitat quality of National Estuarine Research Reserves (NERRs) in the Southeastern U.S.

Integrated Environmental Assessment and Management (IEAM)

W. L. Balthis, **C. Cooksey**, **M. F. Fulton**, **J. L. Hyland**, G. H. M. Riekerk, R. F. Van Dolah, and **E. H. Wirth (NOS/NCCOS)**

- Southeastern NERR sites are faring slightly better than neighboring non-NERR estuaries with respect to overall habitat quality, with poor habitat quality limited to relatively small areas. However, indications of environmental stress, accompanied in some cases by biological impacts, suggest that these areas are not free from pressures that may originate from within or outside NERR boundaries.
- The findings serve to highlight the value of preserving and protecting these areas (NERR sites) from any additional impacts to the extent possible.

Multiple indicators of water quality, sediment quality, and biological condition were used to assess the status of ecological condition of National Estuarine Research Reserve System (NERRS) sites in NC, SC, and GA relative to a suite of corresponding scoring criteria. All measurements were made in subtidal aquatic habitats. Calculated scores were integrated into an overall index of habitat quality and used to make comparisons among the various NERR and non-NERR estuaries throughout the region. Sediment quality scores varied considerably among NERR sites, but in most cases were similar between individual NERR and non-NERR sites in corresponding states. Water quality and biological condition indicators scored consistently higher for NERRs versus non-NERR sites. Overall habitat quality scores also were consistently higher for NERRS sites, suggesting that these areas are on par with if not in slightly better condition ecologically than neighboring non-NERR estuaries. Portions of individual NERR sites rated as poor with respect to overall habitat quality were limited to relatively small areas (< 13% of a reserve's total sampling area).

Expected publication date: December 2014

Published Online: http://onlinelibrary.wiley.com/doi/10.1002/ieam.1601/pdf

ADDITIONAL ARTICLES

NMFS Publications

Synchronized migration phenologies prevent trophic mismatch in a warming watershed

Freshwater Biology (2.905)

C. J. Sergeant, J. B. Armstrong, and **E. J. Ward (NMFS/NWFSC)**

- This study used a 10-year dataset to ask how predators respond to fluctuations in prey in a system that has a strong climate signal associated with global warming.
- The authors found that the generalist species studies was able to buffer their response to climate fluctuations by exploiting other prey.
- In contrast to many previous studies, these results suggest that some wide-ranging predators may be resilient to altered prey phenology due to climate change.

Animal migrations often evolve to exploit seasonal variation in foraging opportunities. Many migrants move among discrete habitats using environmental cues such as temperature or photoperiod to time their arrivals with seasonal peaks in food abundance. This type of migratory behavior has been hypothesized to be particularly vulnerable to climate change, which can generate asynchrony between the seasonal timing (phenology) of animal movements and periods of peak resource abundance in destination habitats. While many studies have documented climate-induced mismatch between migrants and the lower trophic levels they target, virtually none have explored the consequences of altered migration phenology on the higher trophic levels that migrants often subsidize. This study explores the roles of climate change and prey migrations in driving the seasonal migrations of predators. Here the authors show that in a warming watershed where prey migrations have changed substantially over the last 4 decades, predator migrations remain synchronized with prey and appear to be cued most directly by prey migration rather than environmental conditions.

Expected publication date: January 2015

Reducing bias and improving precision in species extinction forecasts
Ecological Applications (3.86)
K. E. See and **E. E. Holmes (NMFS/NWFSC)**

- This paper provides guidance for the study design of monitoring threatened or endangered species of conservation concern.

Forecasting the risk of population decline is crucial in the realm of biological conservation and figures prominently in population viability analyses (PVA). The most common form of available data for a PVA is population counts through time. Previous research has suggested that improving estimates of population trends depends on longer time series, but that is often impractical or undesirable. Spatial replication of observations is an alternative way to gather more data without extending the time series. In this paper, we examine the tradeoff between the length of the time period over which observations of the population have been taken, and the total number of observations or samples that have been recorded through an analysis of simulated data. We found that when there is a low process to non-process error variance ratio there are benefits to sampling less frequently but extending the period over which counts are gathered, but when that ratio is high more precise estimates of quasi-extinction risks can be obtained if replicated observations are taken at each time step. These results can be used to efficiently design effective monitoring schemes for species of conservation concern.
Accepted: 4 November 2014

Clarification on the fecundity of Rhinoptera bonasus *(Mitchill)*
Southeastern Naturalist (0.382)
C. M. Jones and **W. B. Driggers III (NMFS/SWFSC)**

- Maximum fecundity for the crownose ray, Rhinoptera bonasus has been overestimated based upon misidentification.
- This study provides evidence demonstrating that proper identification in the field and laboratory are key to the accurate reporting of biological parameters essential to population dynamics models.

Accurate fecundity estimates are necessary for the proper assessment of fish stocks. Despite all recent investigations of the reproductive biology of the cownose ray, *Rhinoptera bonasus*, indicating a maximum fecundity of two embryos per brood, maximum fecundity estimates of six per brood persist. All reports of six embryos per brood seem to stem from a single account. It is the purpose of this paper to present evidence indicating that the report of six embryos is based upon a misidentification in the field and that maximum fecundity estimates for the cownose ray are therefore up to six fold higher than actually observed.
Accepted: 3 November 2014

NOS Publications

Potential larval sources, destinations, and self-seeding patterns in the Mariana Archipelago documented using ocean drifters

Journal of Oceanography (1.464)

M. S. Kendall and **M. Poti (NOS/NCCOS/CCMA)**

- Based on evidence from drifters it appears that the Marianas are rather isolated from their island neighbors as either a destination or source of larvae.
- If most larvae arriving at the Marianas are self-seeded, it means that management decisions made in the Marianas will have especially potent local consequences. Maintaining healthy spawning docks will have locally realized benefits and sustain resilient populations.
- Over-harvesting local stocks will impact future fishing success with little replenishment of new fish imported from other, healthier populations. Exceptions are noted, and islands up-stream are identified that should be the focus of coordinated management decisions.

Identifying transport pathways and sources of reef larvae is an essential component of ecosystem science. Ocean drifters tracked by satellite around the Mariana Archipelago were used to evaluate the possible pathways of transport among islands for passive larvae of reef organisms present in the surface layer. Reef taxa vary in their minimum and maximum larval duration from several days to a few

months. Drifters leaving the Marianas required >16 days of transport prior to arriving near any adjacent island groups. Drifters arriving at the Marianas required >35 days of transport before being tracked back to any adjacent island groups. All arrived from the east or southeast via the North Equatorial Current. Roughly 27% of the drifters that began in the Marianas returned. The majority of returning drifters (65%) ended to the north of their starting point. Over 70% of the drifters that returned to the Marianas after starting there did so in <40 days. Overall, this suggests that self-seeding may be of great importance to sustaining Mariana reef populations and that position within the archipelago affects connectivity among islands.
Expected publication date: February 2015

NESDIS Publications

Calculation and evaluation of an air-freezing index for the 1981-2010 climate normals period in the coterminous United States
Journal of Applied Meteorology and Climatology (2.02)
R. Bilotta, J. E. Bell, E. Shepard, and **A. Arguez (NESDIS/NCDC)**

- Air-Freezing Index (AFI) is a common metric for determining the freezing severity of the winter season and estimating frost depth for mid-latitude regions, which is useful for determining the depth of shallow foundation construction.
- An accurate estimate of maximum soil frost depth allows for reduced construction cost and proper preparation for future climate conditions.

Air-Freezing Index (AFI) values represent the seasonal magnitude and duration of below freezing air temperature. Departures of the daily mean temperature above or below 0°C (32°F) are accumulated over each August—July cold season; the seasonal AFI value is defined as the difference between the highest and lowest extremes points. Return periods are computed using generalized extreme value distribution analysis. This research replaced the methodology used by NOAA to calculate AFI return periods for the 1951-1980 time period, applying the new methodology to the 1981-2010 climate normals period. Seasonal AFI values and

return period values were calculated for 5600 stations across the coterminous United States (CONUS), and the results were validated using United States Climate Reference Network temperature data. Return period values were typically 14-18% lower across CONUS during 1981-2010 versus a re-computation of 1951-1980 return periods with the new methodology. For the 100-year (2-year) return periods, about 59% (83%) of stations showed a decrease of more than 10% in the more recent period, whereas 21% (2%) showed an increase of more than 10%, indicating a net reduction in winter severity consistent with observed climate change. Comparing the 1981-2010 return periods with re-calculated 1951-1980 values using the same new methodology, a decrease in winter severity across much of CONUS became apparent. Return period values were typically 14-18% lower in the 1981-2010 period, with a median difference (across CONUS stations for which return periods were calculated) of -66 FDDs for the 2-year return periods and -175 for the 100-year return periods. Over 58% of stations had a 100-year return period value that was at least 10% higher in the 1951-1980 period versus 1981-2010, whereas about 20% of stations showed the opposite. However, care must be taken when comparing 100-year return periods from consecutive 30-year periods, as the difference is largely a function of the coldest year in each period. Differences in shorter return periods, such as the 2-year, are more in tune with observed climate change. Over 82% of stations had a 2-year return period value that decreased by more than 10% from 1951-1980 to 1981-2010, while the converse occurred for less than 2% of stations.
Accepted: 26 October 2014

Extended reconstructed sea surface temperature version 4 (ERSST.v4), part I. Upgrades and intercomparisons
Journal of Climate (4.36)
B. Huang (NESDIS/NCDC), V. F. Banzon (NESDIS/NCDC), E. Freeman (NESDIS/NCDC), J. Lawrimore (NESDIS/NCDC), W. Liu (NESDIS/NCDC), T. C. Peterson (NESDIS/NCDC), T. M. Smith (NESDIS/STAR), P. W. Thorne, **S. D. Woodruff (NESDIS/NCDC),** and **H-M. Zhang (NESDIS/NCDC)**

- The ERSST has been updated to a new version. The difference among reconstructed SSTs in independent research institutions are mostly associated with the SST bias adjustments applied in the SST reconstructions.
- SSTs in ERSST.v4 are as close to satellite-based observations as other similar SST analyses.
- Compared with v3b, SSTAs in ERSST.v4 can substantially better represent the El Niño/La Niña behavior when observations are sparse before 1940.

The monthly Extended Reconstructed Sea Surface Temperature (ERSST) dataset, available on global 2°×2° grids, has been revised herein to version 4 (v4) from v3b. Major revisions include: updated and substantially more complete input data from the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) Release 2.5; revised Empirical Orthogonal Teleconnections (EOTs) and EOT acceptance criterion; updated sea surface temperature (SST) quality control procedures; revised SST anomaly (SSTA) evaluation methods; updated bias adjustments of ship SSTs using Hadley Nighttime Marine Air Temperature version 2 (HadNMAT2); and buoy SST bias adjustment not previously made in v3b. Tests show that the impacts of the revisions to ship SST bias adjustment in ERSST.v4 are dominant among all revisions and updates. The effect is to make SST 0.1°C-0.2°C cooler north of 30°S but 0.1°C-0.2°C warmer south of 30°S in ERSST.v4 than in ERSST.v3b before 1940. In comparison with the UK Met Office SST product (HadSST3), the ship SST bias adjustment in ERSST.v4 is 0.1°C-0.2°C cooler in the tropics but 0.1°C-0.2°C warmer in the mid-latitude oceans both before 1940 and from 1945 to 1970. Comparisons highlight differences in long-term SST trends and SSTA variations at decadal timescales among ERSST.v4, ERSST.v3b, HadSST3, and Centennial Observation-Based Estimates of SST version 2 (COBE-SST2), which is largely associated with the difference of bias adjustments in these SST products. The tests also show that, when compared with v3b, SSTAs in ERSST.v4 can substantially better represent the El Niño/La Niña behavior when observations are sparse before 1940. Comparisons indicate that SSTs in ERSST.v4 are as close to satellite-based observations as other similar SST analyses.

Expected publication date: 8 December 2014

Joint Line Office Publications

Changes in nitrogen oxides emissions in California during 2005-2010 indicated from top-down and bottom-up emission estimates

Journal of Geophysical Research: Atmospheres (3.44)

M. Huang, K. W. Bowman, G. R. Carmichael, **T. Chai (OAR/ARL)**, **R. B. Pierce (NESDIS/STAR)**, J. R. Worden, M. Luo**, I. B. Pollack (OAR/ESRL), T. B. Ryerson (OAR/ESRL), J. B. Nowak (OAR/ESRL),** J. A. Neuman **(OAR/ESRL)**, J. M. Roberts **(OAR/ESRL)**, E. L. Atlas, and D. R. Blake

- Nitrogen Dioxide (NO_2) is one of the six criteria air pollutants regulated by the US Environmental Protection Agency (EPA). In addition to its own impacts on human health, NO2 is one of a group of highly reactive nitrogen oxides (NO_x) gases that affects tropospheric chemistry and contributes to the formation of near-surface ozone and particulate matter (PM) pollution.
- This study shows the potential of using space/ground-based monitoring data and advanced data assimilation approaches to update NOx emission estimates on a monthly scale and at a fine grid resolution.
- The top-down NO_x emission estimates are close to the latest California Air Resources Board bottom-up inventory.
- Applying these updated NO_x emission estimates for California reduced overall uncertainties in modeled surface O_3 levels across the western US.

In California, emission control strategies have been implemented to reduce air pollutants. In this study, the authors estimate changes in nitrogen oxides (NO_x = NO + NO_2) emissions from 2005–2010 using a four-dimensional variational approach. They separately and jointly assimilate surface NO_2 concentrations and tropospheric NO_2 columns observed by Ozone Monitoring Instrument (OMI) into the regional-scale Sulfur Transport and dEposition Model (STEM) chemical transport model on a 12 × 12 km^2 horizontal resolution grid for May 2010. The assimilation generates grid-scale top-down emission estimates, and the updated chemistry fields are evaluated with independent aircraft measurements during the

NOAA California Nexus (CalNex) field experiment. The emission estimates constrained only by NO_2 columns, only by surface NO_2, and by both indicate statewide reductions of 26%, 29%, and 30% from ~0.3 Tg N/yr in the base year of 2005, respectively. The spatial distributions of the emission changes differ in these cases, which can be attributed in part to differences in the observation sampling strategies and their uncertainties and differences in the sensitivities of column and surface NO_2 with respect to NO_x emissions. The updates in California's NO_x emissions reduced the mean error in modeled surface ozone in the Western U.S., even though the uncertainties in some urban areas increased due to their NO_x-saturated chemical regime. Similar statewide reductions in NO_x emissions have been demonstrated by several independently developed inventories: ~30% in the California Air Resources Board bottom-up inventory, ~4% in the 2008 National Emission Inventory, and ~20% in the annual mean top-down estimates by Lamsal et al. using the global Goddard Earth Observing System (GEOS)-Chem model and OMI NO_2 columns. Despite the grid-scale differences among all top-down and bottom-up inventories, they all indicate stronger emission reductions in the urban regions.
Expected publication date: 1 December 2014
Published online: http://onlinelibrary.wiley.com/doi/10.1002/2014JD022268/pdf

Bias adjustment of AVHRR SST and its impacts on two SST analyses
Journal of Atmospheric and Oceanic Technology
B. Huang (NESDIS/NCDC), W. Wang (NWS/CPC), C. Liu (NESDIS/NCDC), V. Banzon (NESDIS/NCDC) H. Zhang (NESDIS/NCDC), and **J. Lawrimore (NESDIS/NCDC)**

- Satellite SST bias adjustment is critically dependent on many parameters of the algorithm, which largely contributed to the SST reconstruction that includes the satellite observations.
- The SST difference between operational ERSST (without using satellite SST) and OISST (using satellite SST) is not because ERSST does not

include satellite SST but because OISST applies a unique adjustment upon the satellite SST.

- Although satellite SST adjustment can critically impact the reconstructed SST datasets, the difference of reconstruction methods (ER and OI) contributes little to the reconstructed SST difference.

Sea Surface Temperature (SST) observations from satellite-based Advanced Very High Resolution Radiometer (AVHRR) instrument exhibit biases. Adjustments necessary for removing the AVHRR biases have been studied by progressive experiments. These experiments show that the biases are sensitive to various parameters including the length of input data window, the base-function Empirical Orthogonal Teleconnections (EOTs), the ship-buoy SST adjustment, and a shift in grid system. The difference in bias adjustments due to these parameters can be as large as 0.3°C-0.5°C in the tropical Pacific at the monthly timescale. The AVHRR bias adjustments were designed differently in the Daily Optimum Interpolation SST (dOISST) and the Extended Reconstructed SST data sets that ingest AVHRR SSTs (ERSSTsat). The different AVHRR bias adjustments result in the differences in SST data sets in dOISST and ERSSTsat. Comparisons show that the SST difference between these two data sets results largely from the difference in the AVHRR bias adjustments and little from SST analysis methods in the Niño3.4 region as well as in the global oceans. For example, the average difference of the Niño3.4 SSTs between dOISST and ERSSTsat is approximately 0.12°C due to the bias adjustments, and is about 0.01°C due to the analysis methods.Our study finds that the dOISST data sets can be improved by using the revised AVHRR bias adjustment of a wider input data window, updated EOTs, and shifted grid system in dOISST. Improvements can also be made by including a ship-buoy SST adjustment, a zonal SST adjustment or revised EOTs without damping in the high latitudes in ERSSTsat.

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OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

Great Lakes water levels surge, return to normal

EOS

A. D. Gronewold (OAR/GLERL), A. H. Clites (OAR/GLERL), J. Bruxer, K.W. Kompoltowicz, J.P. Smith, T.S. Hunter, and **C. Wong (NOS/COOPS)**

- The current surge in water levels provides significant relief to systems stressed by hydrologic extremes.
- The increase in water levels gives some perspective to the recent period of low water conditions that escalated demands for anthropogenic intervention through the construction of new structures designed to reduce the flow rates through the St. Clair River and increase water levels on Lake Michigan-Huron.
- The fluctuations in hydrological events emphasize the need to improve understanding of how long and short-term climate fluctuations generate into abrupt changes in the regional water budget and water levels.

Water levels on both Lake Michigan-Huron and Lake Superior recently (October 2014) rose above monthly averages for the first time since 1998. Following a period of roughly 15 years of persistently low water levels, the Great Lakes rebounded at the most rapid rate of water level change in recorded history. For example, water levels on Lake Superior rose about 0.7 meters from January 13 through October 2014, the highest rise ever recorded for that 22 month period. Similarly, on Lake Michigan-Huron, water levels rose roughly 1.0 meters from January 2013 through October 2014, the second highest rise ever recorded for that 22 month period. This precedent-setting hydrological event provides further evidence for how the drivers of climate variability can significantly impact regional water budget and lake water levels. These changes, however, remain difficult to predict, identifying the need to improve our understanding of the relationship between climate fluctuations and the Great lakes regional water budget dynamics.

Expected publication date: TBD